5th Grade

Unit 2 Rationale, Strategies, and Misconceptions

Adapted from Progressions from Tools for the Common Core Standards

5.NBT.2 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

Rationale

Students need to fully understand the structure of multiplying by a power of 10; how it shifts the digits of a whole number that many places to the right. For example, multiplying by 10^4 is multiplying by 10 four times (10 x 10 x 10 x 10).

Multiplying by 10 once shifts every digit of the multiplicand one place to the left in the product (the product is ten times as large) because in the base-ten system the value of each place is 10 times the value of the place to its right. Proving why this works with models and other tools is a key goal for understanding in this unit and will prepare and connect students to the decimal work they will do in unit 2.

5.NBT.1 Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and of what it represents in the place to its left.

5.NBT.3 Read, write, and compare decimals to thousandths.

a. Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., 347.392 = 3 x 100 + 4 x 10 + 7 x 1 + 3 x ($\frac{1}{10}$) + 9 x ($\frac{1}{100}$) + 2 x ($\frac{1}{1000}$).

b. Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

5.NBT.4 Use place value understanding to round decimals to any place.

Rationale

Base-ten units

Each place of a base-ten numeral represents a base-ten unit: one, tens, tenths, hundreds, hundredths, etc. The digit in each place represents 0 – 9 of those units. Because ten "like" units make a unit of the next highest value, only ten digits are needed to represent any quantity in base ten. The basic unit is a *one* (represented by the rightmost place for whole numbers). In learning about

whole numbers, children learn that ten ones compose a new kind of unit called a ten…..In learning about decimals, children partition a one into 10 equal-sized smaller units, each of which is a tenth. For example, one hundred can be viewed as a tenth of a thousand, 10 tens, 100 ones or 1000 tenths.

In Grade 5, students extend their understanding of the base-ten system to decimals to the thousandths place, building on their Grade 4 work with tenths and hundredths. Students will extend their understanding by again observing the relationship between adjacent places except now it will include decimals. They will make the connection that "it works the same way" as with whole numbers.

In Unit 2, students continue to build upon their knowledge from unit 1 in these ways:

1. Whole number exponents denote powers of 10 and the pattern of multiplying by a power of 10 works the same way for numbers with decimals (tenths, hundredths, and thousandths) as it does with whole numbers; ex. 25 x 10 = 250 ; 25 ten times is 250; .25 x 10 = 2.5; 25 hundredths ten times is 2.5

2. Multiplying by a power of 10 shifts the digits of a whole number or decimal number (rational number) that many place to the left. (see example above)

3. Patterns in the number of 0s in products of whole numbers and powers of 10 and the location of the decimal point in products of decimals with powers of 10 can be explained in terms of place value.

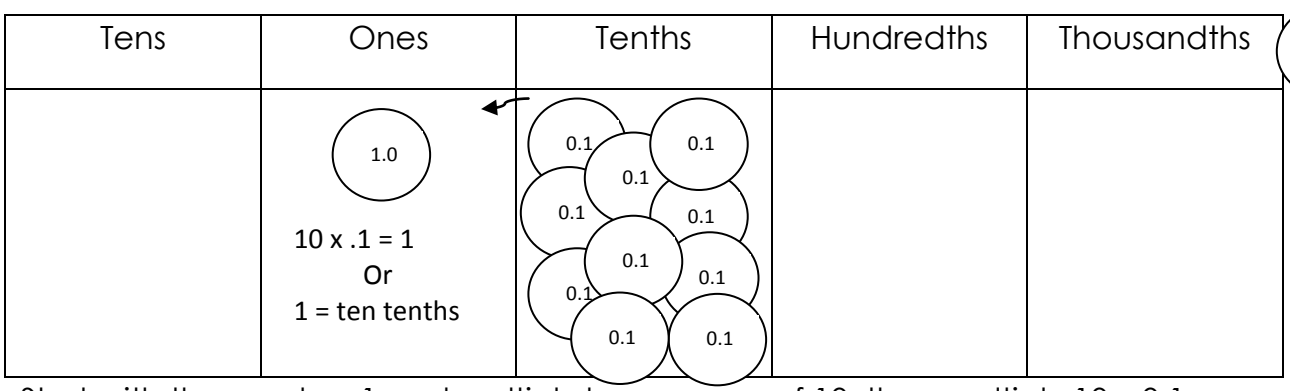
In 4th grade, students developed their understandings of decimals and computations with decimals in terms of multiples rather than powers; in 5th grade connecting the terminology of "multiples" with that of "powers" affords connections between understanding of multiplication and exponentiation. 250 is a multiple of 25. It is the tenth multiple of 25. This is the same as multiplying 25 by a power of 10.

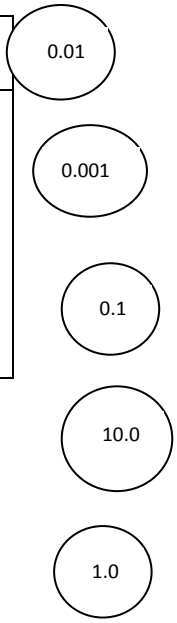
Strategies

In Grade 5, the concept of place value is extended to include decimal values to thousandths. The strategies for Grades 3 and 4 should be drawn upon and extended for whole numbers and decimal numbers. For example, students need to continue to represent, write and state the value of numbers including decimal numbers. They need to continue to compose and decompose decimal numbers as well as compare them. (*For students who are not able to read, write and represent multi-digit whole numbers, working with decimals will be challenging. Specific Intervention)*

Number cards, number cubes, spinners and other manipulatives can be used to generate decimal numbers. For example, a game can be played in which students roll three number cubes. They create the largest and smallest number to the thousandths place. Different challenges for "winning" can be created, i.e. 4 rounds of play – lowest total wins or highest total wins once all four numbers are combined. Make sure students are able to explain the concept or strategy for winning. Students should have practice writing the number with both numerals and words.

Use the "number talk" portion of your instruction to compare and estimate decimal numbers. Look at the structure.
Use unit number discs to understand the pattern of multiplying by a power of 10.





Start with the number 1 and multiply by a power of 10, then multiply 10 x 0.1, then .01 x 10. What happens when you multiply ten times the amount for each place? What happens to the decimal? What happens to the number? Compare the result to either place left or right. How does that compare to multiplying 10 x .1 or 10 x .01? What is happening? Use on the SMARTboard with the cloning tool to make unlimited discs. Write the numbers under each other to observe a pattern. What do you notice? Ask: Will this happen every time? Continue to extend their reasoning to multipliers that are single-digit multiples of .2 and .02, etc.

Common Misconceptions

- The longer the number the greater the number
  With whole numbers, a 5-digit number is always greater than a 1-, 2-, 3-, or 4-digit number. However, with decimals a number with one decimal place may be greater than a number with two or three decimal places. For example, 0.5 is greater than 0.12, 0.009 or 0.499. One method for comparing decimals it to make all number have the same number of digits to the right of the decimal point by adding zeros to the number, such as 0.500, 0.120, 0.009

and 0.499. A second method is to use a place-value chart to place the numerals for comparison.

- Putting a zero at the end of a decimal number makes it ten times as large
- Decimal fractions are "below zero," or negative numbers
- Place value columns include "oneths" to the right of the decimal point
- One-hundredth is written 0.100
- One-fourth can be written either as 0.4 or as 0.25